HOLDING AND RELEASING MECHANISM WITH A SHAPE MEMORY ACTUATOR

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The aim of the invention is to provide a holding and releasing mechanism with a shape memory actuator which enables secure releasing and which has a simple constructive design and requires a minimum supply of energy. To this end, the wire end (7, 8) is held by a loose end of a shape memory wire (9, 10) which longitudinally contracts when the temperature is raised and withdraws its loose end from an aperture (27, 28) formed by the wire end (7, 8). The invention is used in a holding and releasing mechanism with a shape memory actuator which releases a wire end that is under tensile stress in a temperature-controlled manner.

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The invention concerns a holding and a release mechanism with a form memory actuator in accordance with the generic term of the patent claim 1.

It is in space technology admits (DE-A1-196 49,739), to hold a wire standing under tension at its curved end with a Schmelzdraht which melts with current flow and which wire releases. The wire standing under tension holds, as coil formed, two halves together of a divided pin mounting plate. After a release of the wire the two halves of the pin mounting plate under spring pressure fold apart and the pins can from the pin mounting plate separate. With the pin for example when starting of the rocket solar cell panels of a space vehicle are squeezed together, which are released with reaching the mission goal by the loosening of the pin. The use of a Schmelzdrahtes has the disadvantage of an uncertain and undefined release.

US 5.129.753 reveals a holding and a release mechanism with a form memory actuator. Here a form memory wire is used, which shortens its length in the case of release under rise in temperature and lifts a locking sleeve from a quiescent position. The locking sleeve releases a multipart chuck, which apart-folds and releases a tap, with which the connection is solved.

From US 5.160.233 a pin mounting plate with a form memory actuator is well-known for the employment in the space technology, which for repelling empty Treibstofftanks serves, which are held at a spacecraft with a pin outside. The well-known pin mounting plate releases the pins, as cylinder segments in the pin mounting plate, which from the outside cover a thread with their internal thread, existing on the pin, and thus the pins hold, are pressed apart temperature-steered. Pressing apart takes place in such a manner that the cylinder segments as well as the pin with a cylindrically trained form memory actuator are lifted into a position, moving apart of the cylinder segments lateral in the pin mounting plate permit and that moving apart the cylinder segments takes place via the penetration of the actuator trained at its face as truncated cone into a ring opening formed of the cylinder segments. The form memory actuator expands at temperature temperature in its longitudinal direction and causes thereby that preceding described raising and pressing of the cylinder segments apart. The temperature supply in the case of release takes place by means of joulscher warmth. For pressing the cylinder segments apart a relatively large and strong actuator is necessary and with the Aufeinandergleiten of the parts in the pin mounting plate can problems concerning a cold welding occur. The training of the cylinder segments, their adjustment in the hold mode and the means as moving apart in the release condition require a relatively complex constructional organization.

The invention is the basis the task to create a holding and a release mechanism with a form memory actuator the one safe, releasing with simple constructional organization and small energy input made possible.

This task is solved according to invention by the characteristics of the patent claim 1. Training further of the invention are indicated in the Unteransprüchen.

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The invention uses the characteristics of alloys with form memory, so-called. Shape MEMORY Alloys. Such alloys, z. B. on the basis of TiNi, well-known-prove two exhibit different firm phases, i.e. martensitically at low temperature and austenitic at high temperature with a progressive phasedepressed during one the alloy warmed up. The so-called becomes according to invention. ?One-way effect? of such alloys used. In the martensite a ?pseudoplastic? deformation of the alloy is produced, which well-known-proves in the austenite adjusted by rise in temperature again regresses. One to it following cooling in the martensite does not lead however to a further deformation, but it remains the condition regressed in the austenite.

The holding and release mechanism according to invention have the advantage the fact that it consists of few parts because of which compact building method easily integrable into existing Designs is and thus admitted superstructures simplifiziert. A further advantage of the owner according to invention consists of the fact that after the wire release no blown away parts, like z. B. after a pyrotechnic release, it develops and that no parts are destroyed after the release. By use the austenite starting temperature is appropriate for form memory alloys, which are pre-treated with a special mechanical working on step, clearly over the values of commercially available TiNi alloys. In the case of a use of such alloys wire owners according to invention can be used favourably even with higher ambient temperatures, like them z. B. with space missions to arise can.

On the basis the design remark examples of the invention are more near described.

Fig. 1 shows a pin mounting plate with actuator admission in cut front view,

Fig. the pin mounting plate shows 2 in the released condition under Weglassung of the representation of the actuator admission and

Fig. a plan view of the pin mounting plate shows 3 with removed upper section of the actuator admission.

In Fig. 5 remark example shown of a pin mounting plate 1 consists of two cylinder segments 2 and 3, a mechanical feather/spring 6, a driver 7, a Drahtwicklung 4 with the two wire ends 7 and 8, which end with hakenförmige openings 27 and 28, an actuator admission 11, which consists of a lower part 12, a center section 13 and an upper section 14. In the actuator admission 11 16 a form memory wire 9 and 10 is stored in each case in taken off enular grooves 15 and. The circular form memory wires 9 and 10 are interrupted and rise up with one of their ends by the openings 27 and 28 and hold so the Drahtwicklung together 4 standing by the feather/spring 6 under tension. The pin 20 which can be held rises up with its male thread 5 and its pin extension 18 into a tapped hole of the cylinder segments 2 and 3 held together by the Drahtwicklung 4.

The Auslösezutsand that described pin mounting plate 1 is leading in Fig. 2 shown. By a steered temperature supply the two kontraktieren, in Fig. 2 simplifying not represented, form memory wires 9 and 10 in their longitudinal axis and withdraw themselves from the openings 27 and 28. Thus the Drahtwicklung and the cylinder segment 3 opens 4 folds under effect of the linked up mechanical feather/spring 6 laterally away. The away-folding cylinder segment 3 releases a longitudinal half of the male thread 5. The driver 17 fastened to the cylinder segment 3 affects thereby the pin extension 18 in such a manner the fact that it is laterally carried forward according to the directional marker 29 and thus also with the second longitudinal half of its male thread 5 from the pin mounting plate 1 becomes released.

With the pin 20 is held beipielsweise solar panel together of a spacecraft during the rocket start, whereby the pin by the squeezed together solar panel under in its longitudinal axis more working - pre-loading stands. During the temperature-steered release that becomes preceding described release procedures of the pins due to this pre-loading in accordance with the directional marker 19 after conclusion (see Fig. 1) from the pin mounting plate 1 those removes and releases for solar panel for development.

In Fig. 3 is those preceding described pin mounting plate with removed - and in Fig. 3 - upper section not shown 14 of the actuator admission 11 shown in plan view. The wire ends 8 and 9 of the Drahtwicklung 4 are tangential led from the Drahtwicklung 4 to the actuator admission 11.

In the visible center section 13 the enular groove 16 is trained, in which the form memory wire 10 is stored. In the compound condition of the actuator admission - with put on upper section 14 - the enular groove 16 taken off of the upper section 14 is. The circular form memory wire 10 is interrupted and there with one of its ends with a wire mounting plate 21 in the enular groove 16 held to a place. In addition the wire mounting plate 21 forms an electrical contact between the form memory wire 10 and for conductor 22. The other end of the form memory wire 10 is fixed in the enular groove 16, but rises up into a gap 25, which interrupts the enular groove 16 under a certain angle. The angle results from the tangential arrangement of the wire end 8.

In the gap 25 the end of the form memory wire 10 in the not-warmed up condition martensite by the hakenförmige opening 28 of the wire end 8 standing under tension rises up through. In the case of heating up into the austenite condition the end of the form memory wire pulls itself 10 out of the opening 28 and releases the wire end 8.

The heating up of the form memory wire 10 takes place by means of joulscher warmth. In addition a second power connection 26 at the freely mobile end of the form memory wire 10 is intended, whereby the stripped end of a current leader 23 is mechanically connected in a gap 30, which exhibits for the contraction movement of the form memory wire 10 sufficient width, with the form memory wire 10 arranged transverse to the enular groove.

Different alloys with form memory are applicable; z. B. normal TiNi wires without special mechanical pretreatment with values for the austenite starting temperature within the range between 60 and 80 degrees C. The form memory wire 10 of the remark example is a TiNi wire and is in such a way pre-treated with a special rolling process that the value for the austenite starting temperature of the wire is larger than 100 degrees C.

The other wire end 7 of the Drahtwicklung 4 is in the remark example, according to which leading described remarks to the wire end 8 with the form memory wire 9 held, which is stored in the lower part 12 in the enular groove 15. In addition, it could be one of the wire ends 7 or 8 rigidly in the pin mounting plate fastened. A favourable redundancy for the release of the pin 20 is reached by the solvable mounting plate of both wire ends.

The actuator admission 11 is manufactured from the high temperature-steady plastic Polyetheretherketon (PEEK). This material is qualified as space travel material and the electrical characteristic values concerning. the isolation are very good compared with other Kunsttsoffen. A use of other temperature-steady and electrically isolating materials is possible.

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1. Holding and release mechanism marked by a form memory actuator, which releases temperature-steered a wire end standing under tension, by the fact that the wire end (7, 8) of a loose end of a form memory wire (9, 10) is held, which contracts at temperature temperature in its longitudinal axis and its loose end from one of the wire end (7, 8) draws formed opening (27, 28).

2. Holding and release mechanism according to requirement 1, by the fact characterized that the form memory wire (9, 10) is circularly trained with an interruption.

3. Holding and release mechanism according to requirement 2, by the fact characterized that the form memory wire (9, 10) is taken up in a taken off enular groove (15, 16) and that in the enular groove (15, 16) in the range of the loose end of the form memory wire (9, 10) a gap (25) is intended for the introduction of the opening (27, 28).

4. Holding and release mechanism after one of the requirements 1 to 3, by the fact characterized that the form memory wire (9, 10) contracts by utilization of the ?one-way of effect? of the Formgedächtnismateriales during rise in temperature irreversibly.

5. Holding and release mechanism after one of the requirements 1 to 4, by the fact characterized that the form memory material is based on an TiNi alloy.

6. Holding and release mechanism according to requirement 5, by the fact characterized that the form memory material is a wire pre-treated particularly with a mechanical procedure, which exhibits an austenite starting temperature due to this pretreatment larger than 100 DEG C.

7. Holding and release mechanism after one of the requirements 1 to 6, by the fact characterized that the form memory wire (9, 10) is taken up in an actuator admission (11), which is manufactured from the temperature-steady plastic Polyetheretherketon (PEEK).

8. Holding and release mechanism after one of the requirements 1 to 7, by the fact characterized that the heating up of the form memory wire (9, 10) takes place on the austenite starting temperature by means of Joul warmth.

9. Holding and release mechanism after one of the requirements 1 to 8, by the fact characterized that the holding and release mechanism are used in a pin mounting plate with a Drahtwicklung (4) that the Drahtwicklung (4) holds cylinder segments together (2, 3) against the pressure of of a mechanical feather/spring (6) that in a tapped hole of of the held together cylinder segments (2, 3) under tension of standing pins (20) with its male thread (5) is taken up that the holding and release mechanism/the wire end (n) (7, 8) of the Drahtwicklung (4) holds and after release of the wire ends (7, 8) by the holding and Release mechanism the cylinder segments (2, 3) Auseinanderklappen and the pin (20) release.

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